SCIENCE-BASED PARKNERSHIP TO EFFICIENTLY AND EFFECTIVELY PROTECT SPECIAL HABITATS IN FLORIDA FROM FERAL SWINE

Swine adversely affect the environment in most of the places around the world where they have been introduced into the wild, often making their removal the key to protecting many special habitats, particularly wetlands. Their initial introduction to Florida in 1539 by DeSoto was followed by many others. Today, swine flourish and cause widespread damage. A highly successful collaborative Parknership approach among UDSA/APHIS/W ildlife Services - Florida Operations, UDSA/APHIS/Wildlife Services - National Wildlife Research Center, and the Florida Park Service has produced practical and valuable methods for enhancing swine removal efforts. We highlight those research thrusts here.

Monitoring swine populations is vital to their management. The logistical and theoretical difficulties associated with density estimation methods typically make indices of abundance the only practical means to operationally monitor swine (e.g., Choquenot *et al.* 1996). We have been using an easily-applied passive tracking index (PTI) with good statistical properties to monitor swine distribution and relative abundance (Engeman *et al.* 2001). This low-tech method places tracking plots throughout the area of interest. At each plot, the number of swine intrusions into the plot is recorded for two consecutive days (the plots are resurfaced between days). The PTI and associated variance are calculated according to Engeman (2005), where a mixed linear model describes the number of intrusions on each plot each day. The mean number of track intrusions on each plot is calculated for each day, and the index value is the mean of the daily means. Adding to index s robustness, the variance formula was derived without assuming independence among plots or days (Engeman 2005). Applications of the method have included 1) optimizing the timing and strategy for swine removal, 2) minimizing labor by identifying areas where swine removal would have maximal effect, 3) assessing efficacy of removal efforts, and 4) detecting re-invasion and identifying directions from which re-invasion occurs.

Reduction in swine damage is the ultimate objective for swine removal, making quantification of damage necessary to evaluate control success. Variability among habitats required different damage sampling methods for different circumstances. A quadrat sampling methodology was used in conjunction with the PTI population surveys to estimate the amount of swine damaged habitat (Engeman *et al.* 2003). Each tracking plot location defined the location for 2 damage assessment plots, 1m outward from each road edge. Each damage plot was a 5x1 m rectangle, established by folding a 1x1m PVC pipe square. String placed in a + sign across the square divided it into 4 equal quadrants. Thus, damage was measured over 20 0.25m^2 quadrants for each of the 5x1m plots, providing repeatability within 5%.

Where it was possible to follow a straight-line transect, damage was sampled on transects spaced through the area. This was particularly effective for assessing damage to the exposed portion of an imperiled basin marsh system. Tape measure transects were placed perpendicularly from the water s edge to the interface with surrounding upland vegetation (Engeman *et al.* 2004b). Each transect s total distance was measured, as was the distance directly on the transect that was damaged by swine. This amount could represent a single damage patch or combined distances from multiple patches. The estimated damage was the damage length s proportion of the transect length.

Besides estimating the quantity of swine damaged habitat, we monetarily valued the damage. Determining values for protected habitats is not straight-forward (nor precise). Engeman *et al.* (2004a) discussed a variety of ways to apply monetary values to rare animal species and habitats. Special habitats such as wetlands have limited market value , and if such habitat is selectively protected, the market value diminishes further (King 1998). The use of contingent valuation surveys tend to provide abstract appraisals of value (King 1998), and rarely form the basis for policy decisions (Adamowicz 2004). The most defensible, logical, and applicable valuation for swine damaged habitat was expenditure data for permitted wetland mitigation projects in the United States. Such data represent an empirical demonstration of willingness-to-pay value. King (1998) presented the dollar amounts per unit-area spent in restoration attempts for a spectrum of wetland habitats. Those numbers represent the dollar amounts that environmental regulators, and to a degree elected governments, have allowed permit applicants to spend to replace lost wetland services and values (King 1998). For our economic assessments, we identified the dollar value for habitats in our swine damage circumstances from the studies cited in King (1998).

Estimation of the amount and value of swine damage allowed economic evaluations of swine control using benefit-cost analyses (BCA). The BCA approach involved estimating the monetary value of the benefits of damage saved versus the costs measured in damage lost plus control costs. Benefit-cost ratios (BCRs) were calculated using the standard format of the ratio of benefits to costs (e.g., Boardman *et al.* 1996). BCR>1 implies the rewards for swine removal exceeded the costs. Universally, the economic analyses demonstrated enormous benefit-cost ratios for swine removal.

Each area of research has contributed positively to the efficacy, efficiency, and perception of swine removal efforts. The PTI is an effective tool for planning and assessing swine removal efforts, and for follow-up monitoring to determine if and where additional control is needed. Pro-